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ELECTRIC HEATING DEVICE

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Abstract not available for WO8200935
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The present invention provides a flexible continuous sheet heater having a high uniformity in heat propogation that can replace existing thin-wire and etched foil heaters at a fraction of the cost of the existing devices. It is relatively inexpensive to produce, can be used in a wet or damp environment, has a constant watt density per unit length, and is so designed that the watt density can be varied within wide limits. The heater of the present invention includes a paper or plastic substrate (12) on which is printed a semi-conductor pattern (typically a colloidal graphite ink) having (a) a pair of longitudinal stripes (14) extending parallel to and spaced apart from each other and (b) a plurality of identical bars (18) spaced apart from each other and extending between and electrically connected to the stripes. A metallic conductor (22) (typically copper stripping) overlies each of the longitudinal stripes in face-to-face engagement therewith, and the conductors are held in tight engagement with the stripes by plastic sealing layer (23) that overlies the metallic conductors and the semi-conductor pattern, and stripe associated with the particular metallic conductor, to portions of the substrate that are free from the printed semi-conductor pattern.

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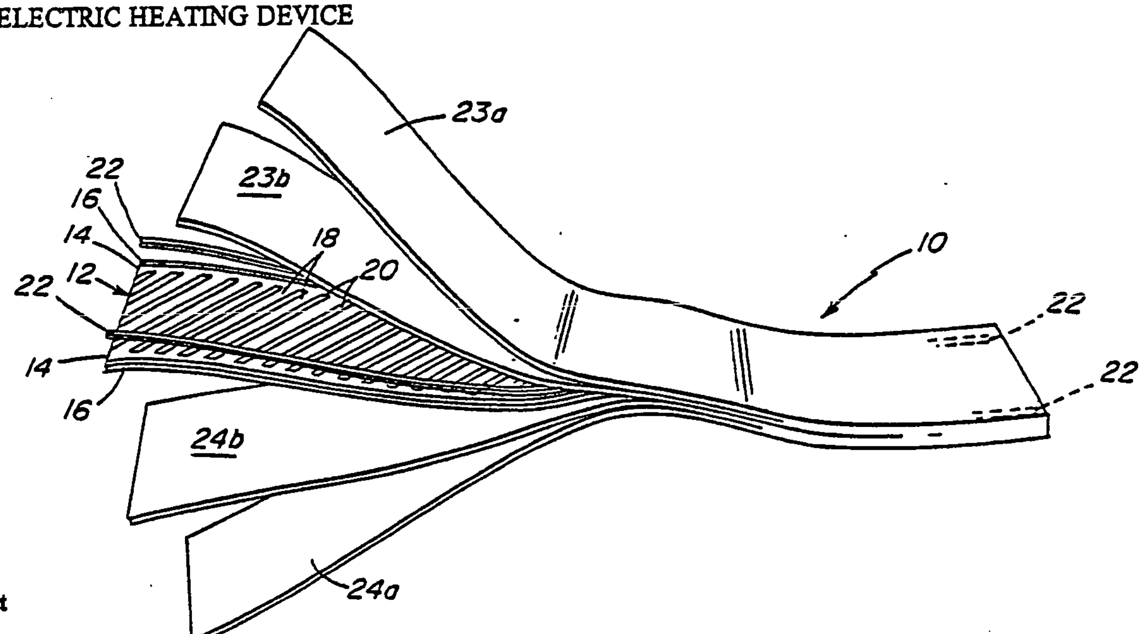

(57) Abstract

The present invention provides a flexible continuous sheet heater having a high uniformity in heat propogation that can replace existing thin-wire and etched foil heaters at a fraction of the cost of the existing devices. It is relatively inexpensive to produce, can be used in a wet or damp environment, has a constant watt density per unit length, and is so designed that the watt density can be varied within wide limits. The heater of the present invention includes a paper or plastic substrate (12) on which is printed a semi-conductor pattern (typically a colloidal graphite ink) having (a) a pair of longitudinal stripes (14) extending parallel to and spaced apart from each other and (b) a plurality of identical bars (18) spaced apart from each other and extending between and electrically connected to the stripes. A metallic conductor (22) (typically copper stripping) overlies each of the longitudinal stripes in face-to-face engagement therewith, and the conductors are held in tight engagement with the stripes by plastic sealing layer (23) that overlies the metallic conductors and the semi-conductor pattern, and stripe associated with the particular metallic conductor, to portions of the substrate that are free from the printed semi-conductor pattern.

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ELECTRIC HEATING DEVICE

Cross-reference to Related Applications

This application is a continuation-in-part of, and claims priority from, U. S. Patent Application Serial No. 181,974 filed August 28, 1981.

Background of the Invention

Many electric heating tapes have been made in the past, most include thin-wire or etched foil heaters and are specifically designed to produce a specific wattage over a predetermined length. Such tapes are generally fairly expensive; it is difficult to vary their watt density; and many cannot be used in wet or damp environments.

Summary of the Invention

The present invention provides a flexible continuous sheet heater having a high uniformity in heat propogation that can replace existing thin-wire and etched foil heaters at a fraction of the cost of the existing devices. It is relatively inexpensive to produce, can be used in a wet or damp environment, has a constant watt density per unit length, and is so designed that the watt density can be varied within wide limits.

In general, the heater of the present invention includes a paper or plastic substrate on which is printed a semi-conductor pattern (typically a colloidal graphite ink) having (a) a pair of longitudinal stripes extending parallel to and spaced apart from each other and (b) a plurality of identical bars spaced apart from each other and extending between and electrically connected to the stripes. A metallic conductor (typically copper stripping) overlies each of the

longitudinal stripes in face-to-face engagement therewith, and the conductors are held in tight engagement with the stripes by a sealing layer that overlies the metallic conductors and is bonded, at opposite sides of the semi-conductor stripe associated with the particular metallic conductor, to portions of the substrate that are free from the printed semi-conductor pattern.

In many preferred embodiments, the substrate, semi-conductor pattern and metallic conductors are hermetically sealed between a pair of plastic sheets. One sheet is positioned on each side of the substrate and the edges of the sheets extend beyond the sides of the substrate and are heat sealed together.

The wattage per unit length (watt density) of the heater is uniform regardless of the overall length of the heater, and any desired length can be cut off a reel and used as desired. Further, without changing either the semi-conductor material, or the thickness or width of the printed bars of the semi-conductor pattern, the watt density of the heater may be varied widely simply by changing the angle between the longitudinal stripes and the bars.

The heater of the instant invention can be made in either sheet (of any desired length and width) or tubular form. Typical uses include area (e.g., wall or floor) heaters, pizza box heaters, thin heaters for pipes, wide heaters for under desks and tables, spaced heaters for greenhouse plant use, and cylindrical hose-shaped heaters.

Brief Description of the Drawings

Figure 1 is a plan view of a heater embodying the present invention.

Figure 2 is a section taken of 2-2 of Figure 1.

Figure 3 is a partially exploded view of the heater of Figure 1.

Figures 4A , 4B and 4C are simplified views illustrating changes in watt density.

Figure 5 is a plan view of a modification of the heater of Figure 1.

Figure 6 is a perspective view of a second modification of the heater of Figure 1.

Figure 7 is a perspective view of a second heater including the invention.

Figures 8-11 are diagramatic views illustrating alternative forms of semi-conductor patterns for heaters embodying the invention.

Detailed Description of Preferred Embodiments

Referring now to Figures 1-3, there is shown a length of an electrical heater generally designated 10, comprising a paper substrate 12 on which is printed, typically by silk-screening, a semi-conductive pattern of colloidal graphite. The graphite pattern includes a pair of parallel longitudinal stripes 14. Each stripe is 0.397 cm. (5/32 in.) wide and the inner edges of the stripes are 8.73 cm. (3 7/16 in.) apart. The overall width of the graphite pattern, thus, is 9.525 cm. (3 3/4 in.); and the substrate 12 on which the pattern is centered is of sufficient width (nominally about 10 cm. or 4 in.) to leave a 0.08 cm. (1/32 in.) to about 0.64 cm. (1/4 in.) uncoated boundary 16 along each edge.

The graphite pattern includes also a plurality of identical regularly-spaced semi-conductor bars 18 extending between stripes 14. Each bar 18 is 0.64 cm. (1/4 in.) wide (measured perpendicular to its edges) and the space 20 between adjacent bars (i.e., the unprinted or "white" space) is 0.32 cm. (1/8 in.) wide. As shown, all of bars 18 extend in straight lines and form an

angle, designated α, of 30° with a line extending perpendicularly between stripes 14. Since bars 18 are twice as wide as the spaces 20 between them, 66 2/3 per cent of the area between stripes 14 is coated with semi-conductor material.

In this and other preferred embodiments, the material forming the semi-conductor patterns of stripes 14 and bars 18 is a conductive graphite ink (i.e., a mixture of conductive colloidal graphite particles in a binder) and is printed on the paper substrate 12 at a substantially uniform thickness (typically about .0025 cm. or .001 in. for the portion of the pattern forming bars 18 and about .0035 cm. or .0014 in. for the portions of the pattern forming stripes 14) using a conventional silk-screen process. Inks of the general type used are commercially available from, e.g., Acheson Colloidals of Port Huron, Michigan (Graphite Resistors for Silk Screening) and DuPont Electronic Materials, Photo Products Department, Wilmington, Delaware (4200 Series Polymer Resistors, Carbon and Graphite Base). A similar product, Polymer Resistent Thick Films, is sold by Methode Development Co. of Chicago, Illinois.

Semi-conductor materials of the type used in the present invention are also discussed in the literature, see for example U. S. Patents Nos. 2,282,832; 2,473,183; 2,559,077; and 3,239,403. The literature teaches that such materials may be made by mixing conductive particles other than graphite, e.g., carbon black or equally finely divided metals or metallic carbides, in a binder; and that the specific resistance of the particle:binder mixture may be varied by changing the amount and kind of electrically conductive particles used. It teaches also that the mixture may be sprayed or brushed onto a variety of different substrate materials.

A copper electrode 22, typically .32 cm. (1/8 in.) wide and .005 cm. (.002 in.) thick, is placed on top of each longitudinal stripe 14. Electrodes 20 are slit from thin copper sheets and, as a result, are slightly curved and have sharp "points" at either side. The electrodes are mounted on stripes 14 with their convex surfaces facing up and the "points" along the edges facing down into and engaging stripes 14. This is most clearly shown in Fig. 2, in which the amount of curvature and size of the "points" of the electrodes is exaggerated for clarity. For long heaters, it is often desirable to increase the thickness of electrodes 22 to .01 cm. (0.004 in.) or so to increase their current carrying capacity.

It will be noted that stripes 18 are wider than either bars 14 or the spaces 20 between adjacent bars. This, coupled with the greater thickness of the stripes relative to the bar (e.g., a stripe thickness of about 1.4 times the bar thickness), reduces the interface resistance from the copper electrodes 22 to the bars 18.

Substrate 12, the graphite pattern (stripes 14 and bars 18) printed thereon and electrodes 22 are hermetically sealed between a pair of thin plastic sheets 23, 24. Each of sheets 23, 24 is a co-lamination of a .005 cm. (0.002 in.) thick polyester ("Mylar") dielectric insulator 23a, 24a and a .007 cm. (0.003 in.) thick adhesive binder, 23b, 24b, typically polythylene. Plastic adheres poorly to graphite, but the polyethylene sheets 23b, 24b bond well to substrate 12 and to each other. In particular, the polyethylene sheet 23b on top of substrate 12 is bonded both to the uncoated paper boundary 16 outside stripes 14 and, on the inside of electrodes 22, to the uncoated paper spaces 20 between adjacent bars 18. Sheet 23b thus holds the electrodes

22 tightly in place against stripes 14. The electrode-to-graphite engagement is further enhanced by shrinkage of plastic sheets 23, 24 during cooling after lamination. Sheets 23, 24 are 0.64 cm. (1/4 in.) wider than substate 12 and are sealed to each other outside the longitudinal edges of substrate 12, providing the desired hermetic seal. It will be noted that stripes 14 are slightly wider than electrodes 22. This extra width is desirable because of manufacturing tolerences to insure that the electrode always fully engages an underlying stripe. However, the extra width should be kept to a minimum to insure that the distance between the uncoated substrate boundary 16 and spaces to which the plastic sheet 23 overlying the electrodes is bonded is as short as possible.

Electric leads 28 connect heater 10 to a source of power 26. As shown, each lead 28 includes a crimp-on connector 30 having pins which pierce the plastic sheets 23, 24 and engage one of electrodes 22.

The resistance of silk-screened semi-conductor pattern (typically over 1000 ohms/square) is much greater than that of the copper electrodes 22 (typically less than 0.001 ohms per square); and it will thus be seen that the watt density (i.e., the wattage per linear foot of heater 10 depends primarily on the length, width and number of bars 18. Mathematically, the watt density (WD), i.e. W/UL, or watts per unit length (e.g., meter, foot, etc.), can be expressed as:

$$WD = \frac{V^2 n}{NbR}$$

where V is the potential difference in volts between the two copper electrodes, n is the number of bars 18 per unit length of tape, N is the inverse of the width of a bar 18, b is the center line length of a bar 18, and R is the resistance of the portion of the printed semi-conductor (e.g., graphite) pattern forming bars 18 in ohms per square.

The spaces 20 between the bars 18 of the semi-conductor pattern provide at least three functions: they provide graphite-free areas at which the plastic sheet 23 or other sealing layer holding electrodes 22 in engagement with stripes 14 may be bonded to the substrate 12; they permit the bars 12 to be oriented at any desired angle relative to the electrodes 22 and stripes 14; and, since a length of stripe 14 equal to the sum of (i) the width of a bar 18 plus (ii) the width of a space 20 is provided at each end of each bar, they increase the electrode-to-semi-conductor contact area for the bars.

Referring now to Figures 4A-4C, there are illustrated three substrates 12a, 12b, 12c, each carrying a respective graphite semi-conductor pattern, designated 11a, 11b, 11c, respectively. The stripes 14a, 14b, 14c, and the bars 18a, 18b, 18c of each pattern are, respectively of the same width and thickness; and the spaces 20a, 20b, 20c between adjacent bars and the distances between stripes 14 are the same also. The only difference between the three substrates is the angle, α, at which the bars 18 are oriented relative to the stripes 14, or more particularly to a line extending perpendicularly between the stripes. On substrate 12a, the bars are perpendicular to the stripes (i.e., $\alpha = 0°$); on substrate 12b, the angle α_b is equal to 45°; and the angle α_c on substrate 12c is equal to 60°. On each of the three substrates, the portion of the graphite semi-conductor pattern forming the bars 18 is printed on the substrate at a resistance of 2875 ohms per square; the two stripes 14 are 2.54 cm. (1 inch apart); and, as with the substrate 12 of heater 10, each bar 18a, 18b, 18c is 0.64 cm. (1/4 in.) wide, and the space between adjacent bars 18 is 0.32 cm. (1/8 in.) wide.

Using the formula provided above, it will be seen that a heater using substrate 12a will have a watt density of 130 watts per meter (40 watts per linear foot); while the watt densities of heaters using substrates 12b and 12c will be, respectively, 65 amd 32.5 watts per meter (20 and 10 watts per linear foot). In each instance, it will of course be recognized that this is the watt density for the portion of the heater in which the bars 18 extend between and are electrically connected to the stripes 14, and does not include the short distance at each end of a heater in which, if the bars are not perpendicular to the stripes, there are a few bars that are not so connected.

Figure 5 shows a modified heater 110 in which the graphite semiconductor pattern is printed on a polyethylene substrate 112 and includes more than two (as shown over 4) longitudinal stripes 114 each underlying and engaging an electrode 122. A set of bars 118 extends between each pair of stripes 114, and as before each bar 118 is wider than the open (no graphite) space 120 between adjacent bars 118. All of the bars 118 are at an angle of 45° to stripes 114; and, as before, the bars 118 are printed on 2/3 of the substrate area between stripes 114, leaving 1/3 of the space for bonding. In the Figure 5 embodiment, however, bars 118 are not solid. Rather, each bar comprises six thin (0.04 cm. or about 0.015 in.) parallel graphite lines spaced 0.08 cm. (about 0.030 in.) apart. The overall width of each bar 118 is about 0.64 cm. (1/4 in.) and the spaces 120 between bases 118 are 0.32 cm. (1/8 in.) wide. The distance between the thin lines forming each bar 118 is such that the heat radiates into the void between adjacent lines.

The multi-line bar design of the Figure 5 embodiment is especially useful when the resistivity of

the semi-conductor graphite material is such that a solid bar would be more conductive than desired. The multi-stripe and electrode design of the Figure 5 embodiment is used when the overall width of the heater is such that a continuous bar 118 extending substantially the full width of the heater would have a greater resistance than desired.

In the Figure 5 embodiment, each of electrodes 120 is held in place by a discrete relatively narrow piece of plastic 123 (e.g., polyethylene) that overlies the particular electrode 120 and is sealed to the plastic substrate 112 at the spaces 120 (or in the case of the electrodes at the edge of the heater to the spaces 120 and boundary 116) on either side of the stripe 114 underlying the particular electrode. As will be seen, the Figure 5 design greatly reduces the amount of plastic required, and thus reduces the cost of the heater; but the lack of a complete hermetic seal can limit the environments in which the heater can be used. In other embodiments, the electrodes may be held in tight engagement with the substrate by, e.g., thermoset resins, elastomers, or other laminating materials. The amount of plastic required can be further reduced by using a paper rather than a plastic substrate.

The heater 202 shown in Figure 6, in which the graphite pattern includes areas 204 about 15 cm. (6 in.) long which include bars 206 interrupted by spaces 208 of equal length on which no bars are printed, is especally suited for greenhouses. A pot containing seeds or seedlings may be placed on each space 204, but no power will be wasted heating the spaces 208 between pots. As will be seen, the bars 206 in the Figure 6 embodiment are printed so that all the bars in each area 204 extend between and are electrically connected to stripes 209.

Figure 7 illustrates a tubular member 210 having a plastic base 212 in which is embedded (or, alternatively, are placed thereon) a pair of elongated parallel electrodes 222 at 180° with respect to each other. The colloidal graphite pattern is printed on base 212 with bars 218 extending helically between longitudinal stripes 214 along each edge of electrodes 222.

Referring now to Figures 8-11 there are shown other graphite patterns that may be used with the heaters of Figures 1, 5 and 7. Each pattern includes a pair of parallel longitudinally-extending stripes, 314, 414, 514, 614, and a plurality of identical bars 378, 418, 518, 618 extending therebetween. In each instance, the bars are at least as wide as the spaces 320, 420, 520, 620 between adjacent bars and are narrower than stripes 314, 414, 514, 614; and each bar is longer than the perpendicular distance between the two stripes it connects. In Figure 8, the bars 318 are smooth arcs; the bars 418 in Figure 9 are S-shaped or reverse curves; the Figure 10 heater has bars 518 in the shape of chevrons; and the bars 618 of the Figure 11 heaters are curved with multiple points of inflection. In each design, typically, the stripes are thicker than the bars.

Claims

1. An electrical heating device comprising

a substrate,

a pair of elongated conductors spaced apart from, and parallel to each other extending longitudinally of said substrate, and

a semi-conductor pattern carried on said substrate between said pair of elongated conductors,

said heating device being characterized in that:

said pattern includes a pair of stripes extending longitudinally of said device generally parallel to and spaced apart from each other and a plurality of bars spaced apart from each other and extending between and electrically connected to said stripes;

all of said plurality of bars are identical to each other and are identically oriented relative to said stripes; and,

a sealing layer overlies at least one of said conductors and the said one of said pair of stripes associated therewith, said layer being sealed at opposite sides of said one conductor to portions of said substrate closely adjacent said one conductor and free from said semi-conductor pattern.

2. The electrical heating device of claim 1 further characterized in that layer extends from one side of one of said stripes to the far side of the other of said stripes and is sealed to portions of said substrate intermediate adjacent ones of said bars, adjacent said one side of said one stripe and adjacent said far side of the other of said stripes.

3. The electrical heating device of claim 1 further characterized in that said bars extend between said stripes other than in straight lines perpendicular to said stripes.

4. The electrical heating device of claim 1 further characterized in that each of said conductors is a metallic strip slightly curved in transverse cross-section and positioned with the convex surface thereof facing away from said substrate.

5. The heating device of claim 1 further characterized in that said bars extend between said stripes in straight lines forming predetermined oblique angles with a line extending perpendicularly between said stripes.

6. The electrical heating device of claim 1 further characterized in that said pattern includes a third said stripe spaced from and parallel to said pair of stripes and a plurality of further bars spaced apart from each other and extending from said third stripe to one of said pair of first stripes, and comprising also a said conductor overlying and engaging said third stripe.

7. The electrical heating device of claim 6 further characterized in that said further bars are substantially identical to said first-mentioned bars and are oriented relative to said third stripe identically to the orientation of said first-mentioned bars relative to one of said pair of stripes.

8. The electrical heating device of claim 1 further characterized in that the resistivity of said conductors is at least an order of magnitude less than that of said bars.

9. The electrical heating device of claim 1 further characterized in that said bars are of substantially uniform thickness, said stripes are of substantially uniform thickness, and the thickness of said stripes is greater than that of said bars.

10. An electrical heating device comprising

a substrate,

a pair of elongated conductors spaced apart from and parallel to each other extending longitudinally of said substrate, and

a semi-conductor pattern carried on said substrate and extending between said pair of elongated conductors,

said device being characterized in that said pattern includes a plurality of substantially identical bars extending between and electrically connected to said conductors, said bars being identically oriented relative to said conductors and extending other than in straight lines perpendicular to said conductors.

11. The electrical heating device of claim 1 or claim 10 further characterized in that said semi-conductor pattern comprises colloidal graphite and a binder.

12. The electrical heating device of claim 1 or claim 10 further characterized in that said bars extend in straight lines at predetermined oblique angles to a line extending perpendicularly between said conductors.

13. The heating device of claim 1 or claim 10 further characterized in that said bars extend in straight lines at predetermined oblique angles relative to said conductors.

14. The heating device of claim 1 or claim 10 including an organic plastic sheet overlying said substrate and attached to portions of said substrate closely adjacent said conductors and not covered by said semi-conductor pattern or said conductors.

15. The heating device of claim 1 or claim 10 further characterized in that said substrate is paper.

16. The heating device of claim 1 or claim 10 further characterized in that said substrate is organic plastic.

17. The heating device of claim 1 or claim 10 further characterized in that each of said bars comprises a plurality of parallel spaced thin lines of semi-conductor material, the distance between adjacent ones of said lines of a said bar being less than half the distance between adjacent ones of said bars.

18. The heating device of claim 17 further characterized in that the distance between each of said lines of a said bar is greater than the width of the lines of said bar.

19. The heating device of claim 1 or claim 10 further characterized in that the width of each of said bars is about twice the width of the space between adjacent ones of said bars.

20. The heating device of claim 1 or claim 10 further characterized in that said pattern is printed on said substrate.such that the resistivity of the portion of said pattern defining said bars is not less than about 1000 ohms per square.

21. The heating device of claim 1 or claim 10 further characterized in that said sealing layer is water-impervious and including a second layer of water-impervious material on the side of said conductors and semi-conductor pattern opposite said sealing layer, each of said layers extending transversely of said device from beyond the outer edge of one of said conductors to beyond the outer edge of the other of said conductors, and said layers being sealed together along respective lines extending longitudinally of said device adjacent the outer edges of said conductors.

22. The heating device of claim 21 further characterized in that said conductors, substrate and semi-conductor pattern are between said sealing layer and said second layer and said layers extend beyond the side edges of said substrate.

23. The heating device of claim 21 characterized in that each of said sealing layer and said second layer is a sheet of organic plastic.

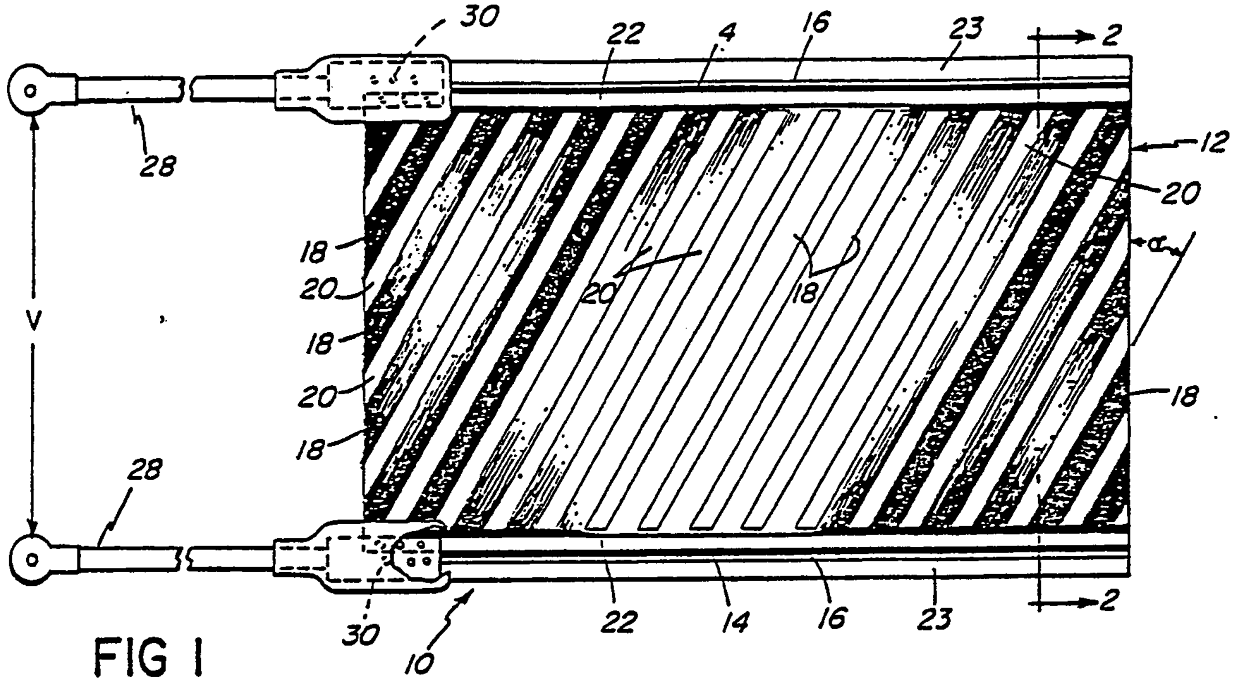


FIG 1

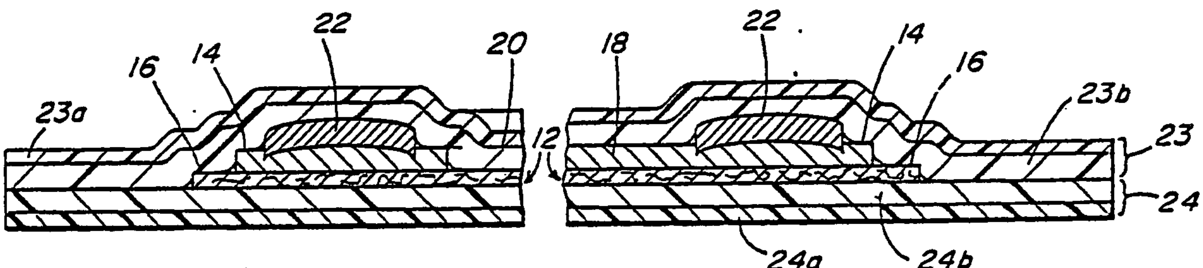


FIG 2

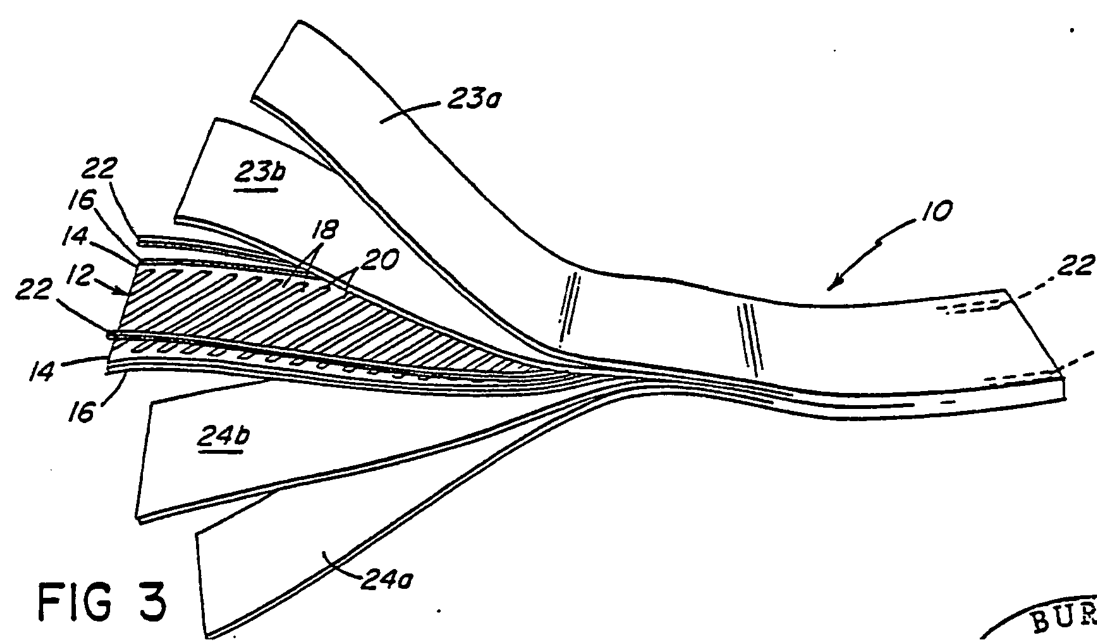


FIG 3

FIG 4A

130 watts/m

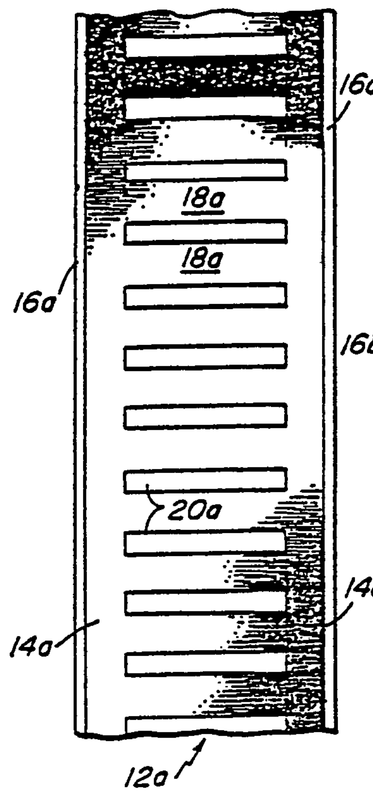


FIG 4B

65 watts/m

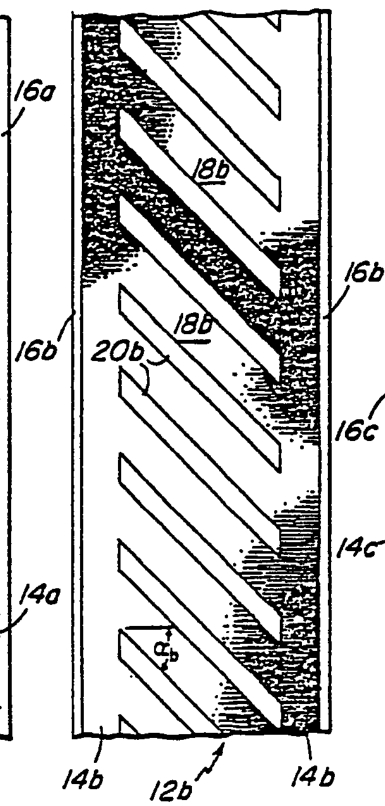


FIG 4C

32.5 watts/m

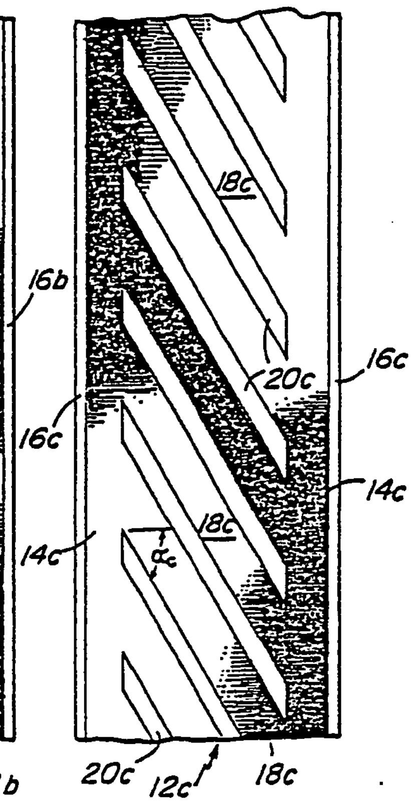
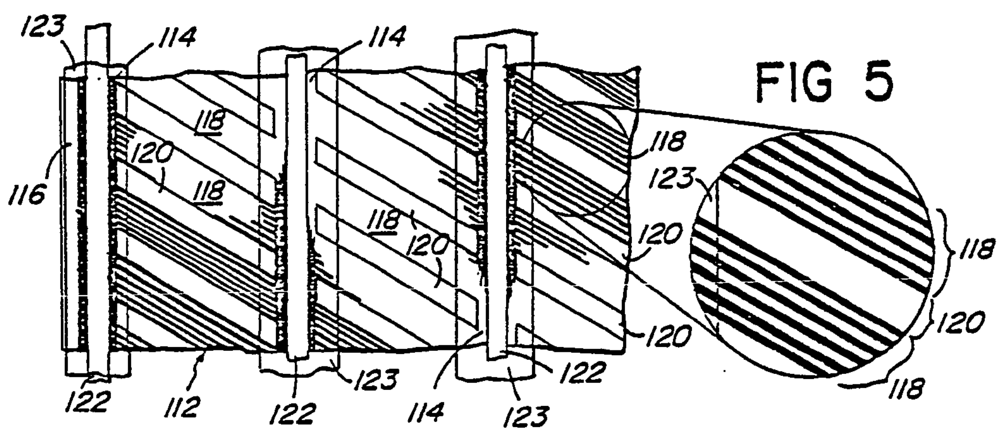


FIG 5



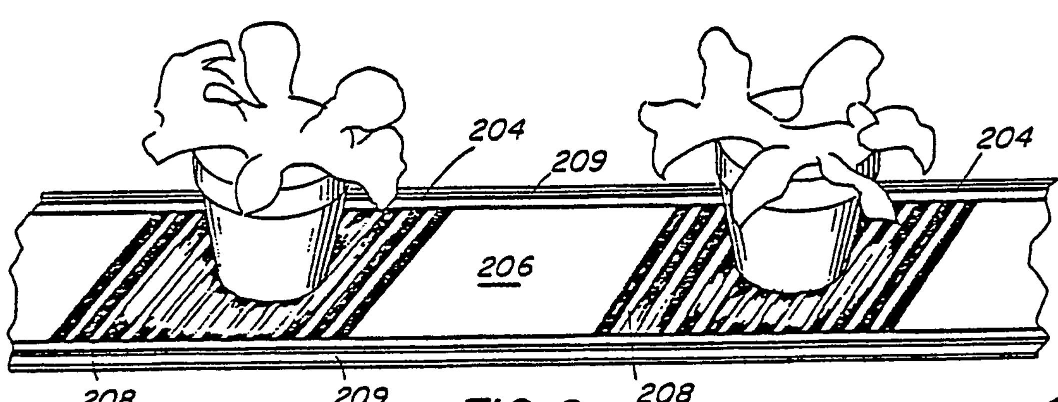


FIG 6

FIG 8

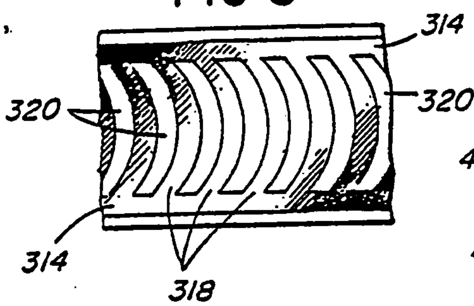


FIG 9

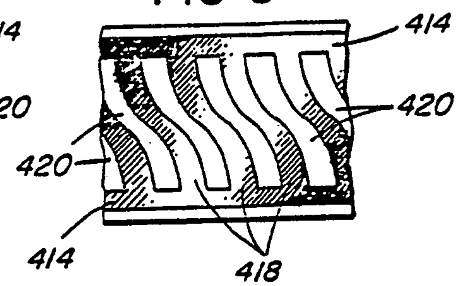


FIG 10

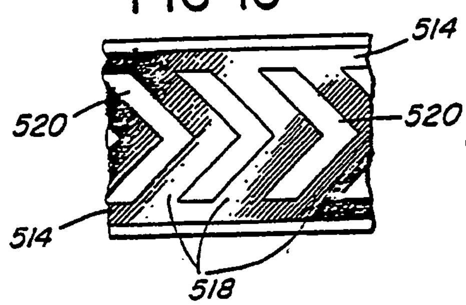


FIG 11

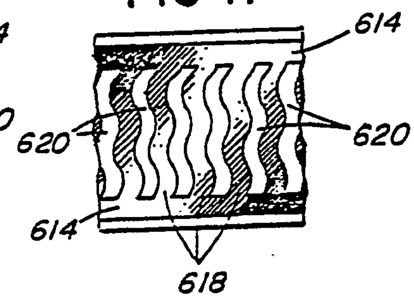
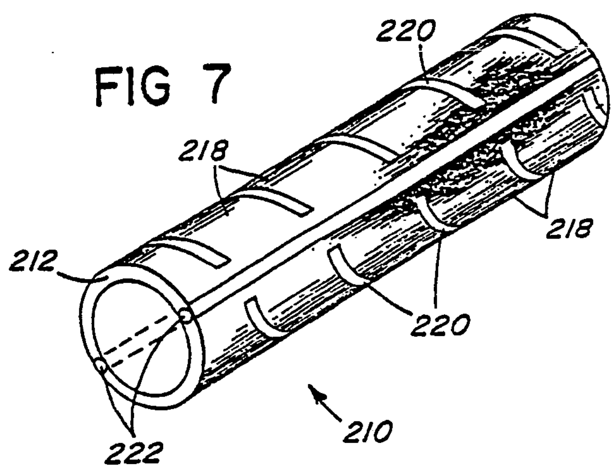


FIG 7



INTERNATIONAL SEARCH REPORT

International Application No PCT/US 81/01131

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL[3] H05B 3/38
U.S. Cl. 174/68.5; 219/528,543,548,549, 338/212

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
US	174/68.5; 219/345,522,528,543,548,549,552; 338/212,308,309,314,322.

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
AX	US,A, 2,473,183, Published 14 June 1949, Watson (see Figs. 4 and 5)	1-23
A	US,A, 2,489,643, Published 29 Nov. 1949 Hunter (see Figs. 5,6 and 8a different semiconductive patterns)	1-23
A	US,A, 2,557,983, Published 26 June 1951, Linder	5,9,12,13
A	US,A, 2,559,077, Published 3 July 1951 Johnson et al (colloidal graphile assemicon-ductor)	1,2,10,11,23
A	US,A, 2,575,987, Published 20 Nov. 1951, York et al see Figs. 1& 3)	1-23
A	US,A, 2,641,675, Published 9 June 1953, Hannahs (see Fig. 1)	1-23
A	US,A, 3,277,419, Published 4 Otc. 1966 Butz (colloidal graphite as semiconductor)	11
A	US,A, 3,514,581, Published 26 May 1970 Rocholl et al (colloidal graphite)	1-9,11, 21-23
A	US,A, 3,683,361, Published 8 Aug. 1972 Salzwedel	10,21,22
A	US,A, 4,072,848, Published 7 Feb. 1978 Johnson et al (see Figs. 3-4)	10-23
AP	US,A, 4,220,848, Published 2 Sept. 1980 McMullan et al	21-23
A	US,A, 3,417,229, Published 17 Dec. 1968 ~~Shomphe et al (see Fig. 2)~~	6,7

* Special categories of cited documents: [15]

"A" document defining the general state of the art

"E" earlier document but published on or after the international filing date

"L" document cited for special reason other than those referred to in the other categories

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but on or after the priority date claimed

"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
17 November 1981	02 DEC 1981
International Searching Authority [1]	Signature of Authorized Officer [20]